PIVOTING SEAT APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit of United States Provisional Application Serial No. 60/416,165 filed on October 4, 2002, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates generally to a seat pivot system for a work vehicle and more particularly to a low profile seat pivot system for a forklift vehicle.

BACKGROUND OF THE INVENTION

The location of the operator's seat in a forklift truck presents a number of problems in the design of a seating system. Because of the design of most forklifts, the operator's seat must be located directly above the engine housing. Further complicating the design is the protective cage or cab which limits the size of any seating suspension or pivot system.

A typical forklift truck as shown in FIG. 1 has a fixed seat facing the direction of the forks. During normal operation of the vehicle, this design mandates that many operations be performed operating the vehicle in reverse. With the forklift unloaded, the operator has a clear forward view and may operate the vehicle in the forward direction. When the vehicle is loaded, however, the operator's forward view may be obstructed by the load forcing the operator to drive the vehicle in reverse. During a typical 8 hour shift, a forklift truck operator may spend as much as 70% of his or her time operating the vehicle in reverse.

The operator's ability to turn towards the rear of a typical forklift is limited by the layout of the vehicle. First, the operator's legs must remain forward to allow the operator to manipulate the vehicle's foot pedals. Second, the seat belt restricts the amount an operator may turn his hips with a standard, forward-facing seat. These limitations force the operator to rotate or twist his neck and upper spine to look toward the rear of the vehicle. Over time, this repeated twisting may lead to an increased incidence of neck and back pain as well as muscle fatigue and/or injury.

Most seats used on forklifts, tug tractors, tow motors, cranes, skid-steer loaders, ground support equipment and the like are fixed in a forward-facing position. In addition

to lacking the ability to turn, these seats force the operator to sit in a fixed posture for the duration of a particular operation. Because fixed seats do not allow spinal movement, performing a task for an extended period of time against a rigid back support without variety in movement can cause muscles to weaken and atrophy, and joints to become inflexible.

Traditionally the solution to this problem has been to provide the work vehicle with a pivotable seat; however, forklift trucks have not been amenable to typical seat pivoting systems such as those using ball bearing turntables. The operator seat in a typical forklift is located directly above the engine housing. The desire to keep the forklift compact prevents relocating the seat with respect to the housing. Further complicating the matter is the fact that most forklifts have a rollover and falling material protection system in the form of a protective cage surrounding the operator which must be a minimum of 35 inches above the H-point of the seat in order to provide sufficient headroom to allow even tall operators to sit upright. Again, the desire to retain a compact design which allows the forklift to pass through doorways and other openings dictates this protective cage be as low as possible. This low height of the protective cage prevents the use of most larger seat pivoting systems in forklifts or vehicles of this type.

The present invention is directed towards overcoming the problems set forth above by providing a compact pivotable seat mechanism and method that allows a vehicle operator to turn the seat in order to relieve muscle tension and to permit an easier view to the rear of the vehicle when moving the vehicle in reverse.

SUMMARY OF INVENTION

One object of the present invention is to provide a work vehicle seat pivot system which allows the operator to rotate the seat from a forward facing position during normal operation of a typical work vehicle.

Yet another object of the present invention is to provide a work vehicle seat pivot system which incorporates a seat suspension system to dampen harmful vibration generated by the operation of the vehicle.

A further object of the present invention is to provide a work vehicle seat pivot system which may be easily retrofit to existing work vehicles, particularly forklift trucks.

Yet another object of the present invention is to provide a seat pivot system which is compact to allow for use in work vehicle protective cages without the loss of operator headroom.

Further objects, embodiments, forms, benefits, aspects, features and advantages of the present invention may be obtained from the description, drawings, and claims provided herein.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a side view of a forklift vehicle for use in describing the embodiments of the present invention.

FIGURE 2 is a side view of a vehicle seat incorporating a pivoting seat apparatus in accordance with an embodiment of the present invention.

FIGURE 3 is top plan view of one component of a vehicle seat pivoting apparatus in accordance with an aspect of the present invention.

FIGURE 4 is a perspective view of the component shown in FIGURE 3, further illustrating an exploded view of one embodiment of a seat locking mechanism.

FIGURE 4A is a detailed view of the seat locking mechanism shown in FIGURE 4, illustrated in an assembled state.

FIGURE 5 is a perspective view of a portion of the component shown in FIGURE 3, further illustrating an exploded view of a seat position release mechanism in accordance with the present invention.

FIGURE 5A is a detailed view of the release mechanism of FIGURE 5, illustrated in an assembled state.

FIGURE 6 is a top plan view of another component of a vehicle seat pivoting apparatus in accordance with an aspect of the present invention.

FIGURE 7 is a top plan view of a component of a vehicle seat pivoting apparatus similar to that shown in FIGURE 6, illustrating another aspect of the present invention.

FIGURE 8 is a perspective exploded view showing the assembly of a portion of the seat pivoting apparatus in accordance with an aspect of the present invention.

FIGURE 8A illustrates the portion of the seat pivoting assemble shown in FIGURE 8, shown in an assembled state.

FIGURE 9 is a perspective exploded view showing the assembly of another portion of the seat pivoting apparatus in accordance with an aspect of the present invention.

FIGURE 9A illustrates the portion of the seat pivoting assemble shown in FIGURE 9, shown in an assembled state.

FIGURE 10 is a perspective exploded view showing the assembly of another embodiment of a seat pivoting apparatus in accordance with the present invention.

FIGURE 10A shows the seat pivoting apparatus of FIGURE 11 in an assembled state.

FIGURE 11 is an exploded side elevational view of one embodiment of a seat pivoting apparatus in accordance with an aspect of the present invention, illustrating its assembly to a vehicle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is hereby intended and alterations and modifications in the illustrated device, and further applications of the principles of the present invention as illustrated herein being contemplated as would normally occur to one skilled in the art to which the invention relates.

The present invention relates to a seat pivot system for a work vehicle, such as a forklift truck 10 as shown in FIGURE 1. Forklift truck 10 includes an engine or motor housing 12 (which will also include the transmission and other components), wheel assemblies 14, which are supported by a suspension system (not shown). Forklift mechanism 16 is mounted to the front of engine housing 12 and incorporates forks 18 and lifting drive 20 of a conventional, known design. A representative load 22 is shown in place on forks 18. Seat 24 is mounted to housing 12 via mounting structure 26, which may include the seat pivoting apparatus of the present invention such as will be described in detail below, as well as other components such as seat adjustment rails and suspension parts. Also shown in FIGURE 1 are steering wheel 28, a representative operation pedal 30, and protective operator shield 32, which may be a cage or enclosed cab, for example.

As can be seen in FIGURE 1, a large load such as load 22 can easily obscure an operator's forward view when operating forklift truck 10, particularly when forks 18 are in a raised position necessary for moving the forklift truck 10. As cab 32 cannot exceed a

height that would prevent forklift truck 10 from passing through doors and under overhead objects, an operator will often decide to drive forklift truck 10 in reverse to obtain a better view of objects and people approaching the moving forklift truck 10.

In accordance with an aspect of the present invention, seat mounting structure 26 comprises a seat pivoting mechanism 34 that permits the operator to turn seat 24 within a prescribed range in order to obtain a better rearward facing view while reducing the amount of neck and back twisting that is required. The construction and operation of seat pivoting mechanism 34 will be described in greater detail below.

FIGURE 3 illustrates one component of seat pivoting mechanism 34, namely a seat plate 36. Seat plate 36 may be manufactured of a variety of materials, such as stamped sheet metal, aluminum, or other materials that are strong and preferably lightweight. Seat plate 36 incorporates a number of holes 38 for mounting seat plate 36 to a vehicle seat for use in vehicles such as forklift 10. Holes 38 are placed in a variety of locations to facilitate retrofitting seat pivoting mechanism 34 to a range of models and vehicles from different manufacturers. Mounting of seat plate 36 to a vehicle seat such as forklift 10 may be by any known means, such as screws or bolts, for example. Holes 38 may also be countersunk to reduce the overall height of mechanism 34. The seat plate 36 shown in FIGURE 3 also has material removed to form a central hole 40 that may accommodate a spring or other suspension component and additionally to reduce the weight of seat plate 36 and hence the overall weight of seat pivoting mechanism 34. Seat plate 36 also incorporates pivot pins 42 which extend perpendicular to the surface of seat plate 36. A portion of seat locking guide 44 is also shown in FIGURE 3.

The construction and operation of seat locking guide 44 is shown in FIGURE 4, which also shows more clearly the structure of pivot pins 42. Seat locking guide 44 includes a pair of tabs 46, extending substantially perpendicular from seat plate 36. Tabs 46 are illustratively shown as being cut and bent from the material of seat plate 36, but they may be separately attached members. Tabs 46 incorporate through holes 48 which are adapted to receive locking pin 50. A biasing member illustratively shown as a compression spring 52 is located between the two tabs 46 so that locking pin 50 passes through spring 52 when locking pin 50 is inserted through holes 48 of tabs 46. A C-clip 54 is used to hold locking pin 50 in place after insertion through holes 48 of tabs 46, but other types of clamps or holding means would be suitable as well. FIGURE 4A shows seat locking guide 44 in an assembled state with locking pin 50 passing through holes 48 of tabs 46 and spring 52, and being held in place by C-clip 54.

FIGURE 5 illustrates an exploded view of one embodiment of the assembly and operation of a release mechanism for locking pin 50. Lever arm 56 incorporates a C-shaped channel 58 which fits around the shaft 60 and below the head 62 of locking pin 50. C-channel 58 is dimensioned to be smaller than the diameter of head 62. Lever arm 56 is shown illustratively mounted to seat plate 36 via bolt 64 and nut 66, although other means of attaching lever arm 56 to seat plate 36 would be equally suitable.

Attached to, and extending outwardly from lever arm 56 is a handle 68 on which is placed a handle cover 70. Handle 68 provides a means to impart a torque moment to lever arm 56 in order to rotate or pivot lever arm 56 about bolt 64. FIGURE 5A shows this release mechanism in an assembled state. In operation, when handle 68 is moved in

direction A (as shown in FIGURE 5A), lever arm 56 rotates around bolt 64 and moves locking pin 50 in direction B.

In accordance with an aspect of the present invention, FIGURE 6 illustrates a pivot or bearing plate 72 which may be manufactured from a variety of suitable materials, preferably an ultra high molecular weight (UHMW) plastic such as UHMW polyethylene. This material is sold commercially under a number of brand names including Trilon AR® by Tri Star Plastics Corp. of Shrewsbury, Massachusetts and Tivar® by Poly-Hi Inc. of Fort Wayne, Indiana. UHMW plastics exhibit excellent abrasion resistance, zero moisture absorption, resistance to UV light and low friction. Preferably the bearing plate will also be impregnated with solid and/or liquid lubricants such as silicone or graphite to further reduce friction between the bearing plate and the seat plate. Bearing plate incorporates a central hole 74 which will correspond in position with hole 40 of seat plate 36, as well as arcuate slots 76 having a curved or elliptical shape, and mounting holes 78. Also shown in FIGURE 6 are rotation stops 80 separated by slot 82. The function of rotation stops 80 and slot 82 will be explained below.

FIGURE 7 illustrates a similar bearing plate 72' having a central hole 74', arcuate slots 76', mounting holes 78', rotation stops 80' and 84, and slot 82'. The distal end of rotation stop 84 extends further than the end of stop 80', compared to rotation stops 80 in FIGURE 6 which are similarly dimensioned. As will be explained in greater detail below, stop 84 is designed to permit seat pivoting mechanism 34 to pivot or rotate only in one direction.

FIGURE 8 illustrates the assembly of pivot or bearing plate 72 with base plate 86. Bearing plate 72' could be substituted for bearing plate 72 without changing the manner

of assembly shown in FIGURE 8. Base plate 86 may be made from the same or similar material to that of seat plate 36. Base plate 86 also incorporates arcuate slots 88, a central hole 90, and a number of mounting holes 92 for mounting or attachment to a vehicle such as forklift 10. Base plate 86 also incorporates holes 94 through which are passed bolts 96. Bolts 96 pass through holes 94 in base plate 86 and holes 78 in bearing plate 72 and are secured by nuts 98. Holes 78 are shown as being countersunk so that nuts 98 will not extend above the upper surface of bearing plate 72. FIGURE 8A illustrates the assembly of bearing plate 72 and base plate 86.

In FIGURE 9, the base plate 86 and bearing plate 72 assembly is shown being assembled to seat plate 36. Pivot pins 42 of seat plate 36, illustratively shown as being threaded, pass through corresponding arcuate slots 76 and 88 of bearing plate 72 and base plate 86, respectively. One or more wing nuts 100 are illustratively shown as being threaded onto pins 42 to securely attach seat plate 36, bearing plate 72 and base plate 86 together.

As can be more easily seen in the assembled view of FIGURE 9A, the end of locking pin 50 fits into slot 82 between rotation stops 80 of bearing plate 72 and maintains the bearing plate and base plate assembly in fixed position with respect to seat plate 36. When handle 68 is moved so as to rotate lever arm 56 and as a result pull locking pin out of engagement with slot 82, seat plate 36 is then allowed to rotate through the angular range determined by the amount that pivot pins 42 are allowed to move within the confines of arcuate slots 76 and 88. Rotation is accomplished by way of bearing plate 72 sliding against seat plate 36. The use of bearing plate 72' instead of bearing plate 72 would allow the bearing plate/base plate assembly to rotate in one

direction only, as the end of pivot pin 50 would not extend beyond the end of rotation stop 84 due to its increased length compared to rotation stops 80. Positioning pivot pins at one extreme of the respective arcuate slots of bearing plate 72 and base plate 86 could also be used to control the direction and/or the degree of rotation. As an illustrative example, the arcuate slots are dimensioned to permit the rotation of a vehicle seat by 15°, although other angles of rotation are of course possible. When handle 68 is released, pivoting or rotation of the bearing plate/base plate assembly will continue until the bearing plate is rotated back to its "home" position where spring 52 will cause pin 50 to again engage slot 82.

FIGURE 10 illustrates another aspect of the present invention in which the seat pivoting mechanism also incorporates vibration dampening structure such as that disclosed in co-pending U.S. Patent Application Serial No. 10/253,042, filed September 23, 2002, which claimed priority from Provisional Application No. 60/324,142, filed September 21, 2001, both being incorporated by reference herein.

In FIGURE 10 there is shown a first base plate 102 and a second base plate 104. Base plate 102 forms an assembly with a bearing plate (not shown) and a seat plate 106. The bearing plate and seat plate 106 may be similar or identical to bearing plate 72 and seat plate 36 previously described. Base plates 102 and 104, in addition to the elements included in base plate 86 such as arcuate slots, mounting holes, and a central hole, also incorporate leaf spring elements 108, which provide vibration dampening in the manner described in co-pending application Serial No. 10/253,042. Base plates 102 and 104 are shown illustratively attached to each other by way of bolts 110 and nuts 112. FIGURE

10A shows a completed seat pivoting assembly, incorporating vibration dampening, in its assembled form.

FIGURE 11 shows a simplified side exploded view that illustrates the various components of a seat pivoting mechanism in accordance with the present invention. A representative forklift housing 12, which could also be a truck bed, or other vehicle mounting seat mounting base, is illustratively shown as the base on which the pivoting mechanism is mounted. Sliding rails 114 are also shown as an example of additional components that could be included. Rails 114 allow the vehicle seat to move forward and backward to permit operators to obtain a desired seat position, through the use of adjustment handle 116, for example. Base plate 86 mounts onto rails 114 through conventional means, while bearing plate 72 and seat plate 36 are assemble together as described above. Seat plate 36 in turn attaches to vehicle seat 24 through conventional means as well. Release arm 68 and pivot pins 42 can also be seen in connection with seat plate 36 in FIGURE 11.

Other embodiments are of course possible. The examples shown illustrate seat pivoting mechanisms or systems having a single bearing plate. The present invention also contemplates a seat pivot system having a greater number of pivot plates and having pivot or bearing plates that are of different shapes and sizes. Additionally, the wide variety of operator's seats available may require different methods of attachment than are described herein. The present invention contemplates seat plates adapted to a variety of means for securing an operator's seat including, but not limited to, such methods as bolts, screws, pins, and clasps. Similarly, the attachment of the base plate to a vehicle may be by similar or other means. Mechanisms allowing for slidable positioning of a seat are

well known in the art and may be incorporated between the base plate of the seat pivot system of the present invention and the work vehicle, such as the sliding rails shown in FIGURE 11, although other adjustment means could be employed.

As the size of forklift or other suitable vehicle seats vary, the dimensions of the seat plate, the pivot or bearing plate and the base plate will vary according to the particular application. The overall height of a seat pivot system according to the present invention is minimized to allow for use in a forklift truck while maintaining as much room as possible for the operator between the seat surface and the forklift's protective cage. According to one embodiment of the present invention, the overall height of the pivot system is no greater than 0.5 inches. As forklift configurations vary, other heights are contemplated by alternate embodiments of the present invention.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes, modifications and equivalents that come within the spirit of the inventions disclosed are desired to be protected. The articles "a", "an", "said" and "the" are not limited to a singular element, and include one or more such elements.